morbidity and mortality. Atrial and ventricular myocytes are specialized, branching muscle cells that are connected end to end by intercalated disks. These disks aid in the transmission of mechanical tension between cells. The myocyte plasma membrane, or sarcolemma, facilitates excitation and contraction through small transverse tubules (T tubules). Subcellular features specific for myocytes include increased mitochondria number for production of adenosine triphosphate (ATP); an extensive network of intracellular tubules, called the *sarcoplasmic reticulum*, for calcium storage; and *sarcomeres*, which are myofibrils comprised of repeating units of overlapping thin actin filaments and thick myosin filaments and their regulatory proteins troponin and tropomyosin. Specialized myocardial cells form the cardiac conduction system (described earlier) and are responsible for the generation of an electrical impulse and organized propagation of that impulse to cardiac myocytes, which, in turn, respond by mechanical contraction.

MUSCLE PHYSIOLOGY AND CONTRACTION

Calcium-induced calcium release is the primary mechanism for myocyte contraction. When a depolarizing stimulus reaches the myocyte, it enters special invaginations within the sarcolemma called T tubules. Specialized channels open in response to depolarization, permitting calcium flux into the cell (Fig. 2-2). The sarcoplasmic reticulum is in close proximity to the T tubules, and the initial calcium current triggers the release of large amounts of calcium from the sarcoplasmic reticulum into the cell cytosol. Calcium then binds to the calcium-binding regulatory subunit, troponin C, on the actin filaments of the sarcomere, resulting in a conformational change in the troponin-tropomyosin complex. The myosin binding site on actin is now exposed, to facilitate binding of actin-myosin cross-bridges, which are necessary for cellular contraction. The energy for myocyte contraction is derived from ATP. During contraction, ATP promotes dissociation of myosin from actin, thereby permitting the sliding of thick filaments past thin filaments as the sarcomere shortens.

The force of myocyte contraction is regulated by the amount of free calcium released into the cell by the sarcoplasmic reticulum. More calcium allows for more frequent actin-myosin interactions, producing a stronger contraction. On repolarization of the sarcolemmal membrane, intracellular calcium is rapidly and

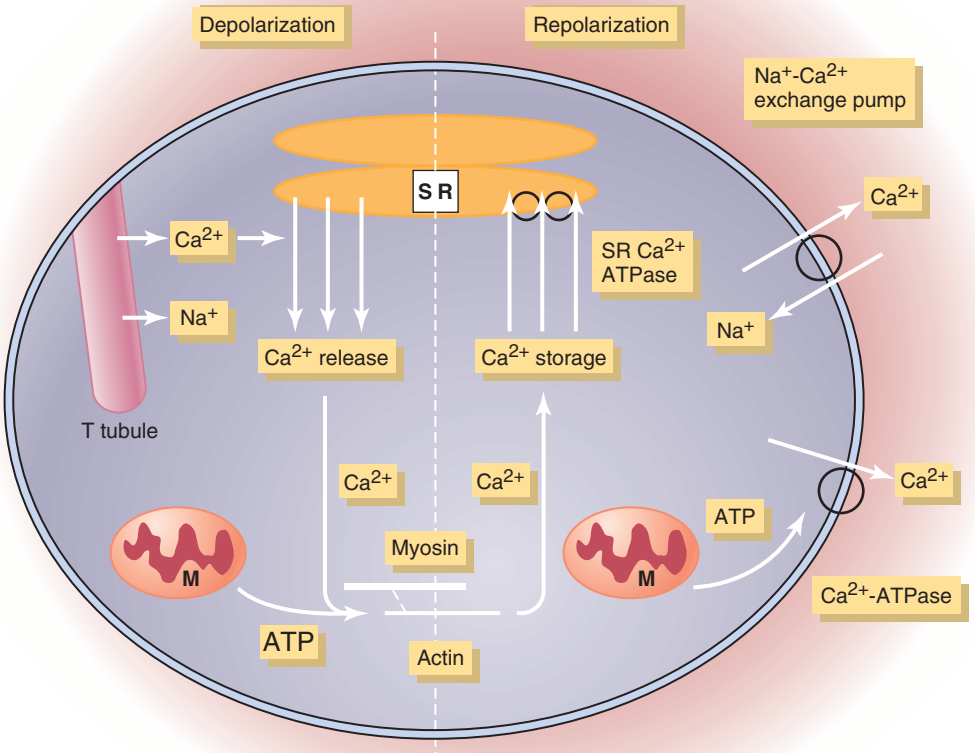

FIGURE 2-2 Calcium dependence of myocardial contraction. (1) Electrical depolarization of the myocyte results in an influx of Ca^{2+} ions into the cell through channels in the T tubules. (2) This initial phase of calcium entry stimulates the release of large amounts of Ca^{2+} from the sarcoplasmic reticulum (SR). (3) The Ca^{2+} then binds to the troponin-tropomyosin complex on the actin filaments, resulting in a conformational change that facilitates the binding interaction between actin and myosin. In the presence of adenosine triphosphate (ATP), the actin-myosin association is cyclically dissociated as the thick and thin filaments slide past each other, resulting in contraction. (4) During repolarization, the Ca^{2+} is actively pumped out of the cytosol and sequestered in the SR. ATPase, Adenosine triphosphatase; M, mitochondrion.